Breeding beans (Phaseolus vulgaris) for BCMV resistance in Zimbabwe

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Beans are the preferred grain legume in Zimbabwe and are widely cultivated by small-scale subsistence farmers. The cultivars currently grown are large-seeded cranberry and red types, susceptible to a number of diseases, among which BCMV is one of the most important. Necrotic strains of BCMV have been found to prevalent in Zimbabwe (Spence and Walkey, 1991). Breeding for resistance is the only feasible way to control BCMV, but resistance must be combined with other characteristics if the resistant cultivar is to be accepted by farmers and consumers. A backcross breeding strategy was therefore followed, to incorporate the bc3 gene (which is resistant to all known strains of BCMV) into Zimbabwean cultivars. However, in backcross breeding, linkage of the genes to be transferred, either with major genes or with polygenes, may impede the recovery of the genetic background of the recurrent parent. The aim of the experiment described here was to assess the ease with which the quantitative characters required by Zimbabwean farmers and consumers could be recovered.

Six resistant lines obtained from CIAT were backcrossed to five standard cultivars. All the resistant lines carried the I + bc3 gene combination and were small seeded. Up to three cycles of backcrossing were completed. After each cycle, a generation of selfing was carried out, during which the plants were inoculated with a mixture of BCMV strains NL3 and NL6, in order to identify plants carrying the bc3 gene, which were symptomless. Only these symptomless plants were used as parents for the following backcross. The standard and resistant parents, P1 and P2 respectively, and the selfed progeny of the three cycles, B1s, B11s and B111s respectively, were then tested in the field. Time to flowering and maturity were recorded, and seed yield and seed size were measured. Cooking time was measured using a Mattson cooker.

The large seed size of the recurrent parents was consistently easily recovered (table 1a). The early flowering of the recurrent parents, on the other hand, was recovered in some crosses but not in others (table 1b), and similarly variable results were obtained for days to maturity (fig 1). The

Table 1. Quantitative characteristics in backcrosses of BCMV resistant cultivars to standard cultivars

Cross	P1	P2	B1s	B11s	B111s
a) seed size (mg)					
RCW x MCM 3030	389.0	185.5	305.5	373.0	384.5
RCW x MCM 1018	389.0	226.5	296.0	352.0	386.0
RCW x MCM 5001	389.0	237.0	312.5	-	-
RCW x MCM 5002	389.0	225.0	313.0	326.5	350.0
Natal Sugar x MCM 3030	346.5	185.5	303.5	-	-
Natal Sugar x MCM 2001	346.5	226.5	375.0	-	-
Natal Sugar x MCM 1018	346.5	226.5	329.5	403.5	371.5
Natal Sugar x MCM 5001	346.5	237.0	353.5	-	-
Natal Sugar x MCM 5002	346.5	225.0	352.5	-	-
(LSD = 44.6)					
b) days to flowering					
RCW x MCM 3030	34	43	35	39	42
RCW x MCM 1018	34	48	47	35	39
RCW x MCM 5001	34	45	34	-	-
RCW x MCM 5002	34	45	35	40	34
Natal Sugar x MCM 2001	42	46	45	-	-
Natal Sugar x MCM 5001	42	45	45	-	-
(LSD = 3.0)					

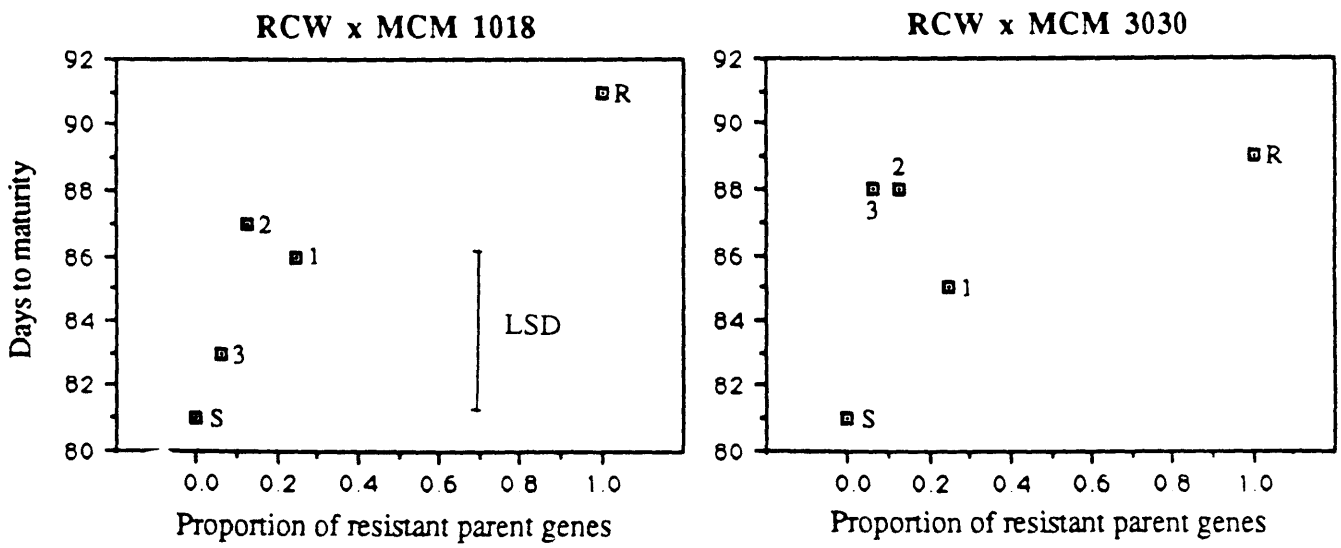
resistant cultivars had shorter cooking times than the standard cultivars, but long cooking time was not generally recovered. This result may reflect a favourable linkage, since fast cooking is preferable, but should be treated with caution since the test was conducted on fresh seed, and cooking time is affected by hardening during storage, to different extents in different genotypes. Moreover, cooking time is more prone to error variation than seed size of flowering time. The yields of the resistant cultivars were generally higher than those of the standard parents, but there was no consistent pattern in the yields of the progeny.

Overall, these results indicate that there are good prospects for developing BCMV resistant bean cultivars that possess the characteristics required for utilisation in Zimbabwe.

Reference

Spence, N.J. and Walkey, D.G.A. (1991) Identification of strains of BCMV occurring in different regions of Africa. Annual Report of the Bean Improvement Cooperative 34, 5-6.

Figure 1. Days to maturity of parental and backcross generations of two crosses



S = Standard parent

R = Resistant parent

1 = First backcross progeny

2 = Second backcross progeny

3 = Third backcross progeny